Model

S-12-D AND G AMPLIFIER

IN ALL CORRESPONDENCE WITH THE FACTORY BE SURE TO INCLUDE THE FOLLOWING INFORMATION:

EQUIPMENT MODEL NUMBER

SERIAL NO. 342

LING NO. 41850

MP MASTER
MA34254

LING ELECTRONICS Division
LING-TEMCO-VOUGHT, INC.
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Anaheim, California

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SECTION 1
DESCRIPTION AND CHARACTERISTICS

1-1. GENERAL

The Ling Electronics Model S-12-D & G Amplifier is one component chassis of a servo system used in vibration testing; it maintains one or more vibration quantities constant at an electronically driven shaker. Depending on the application of the servo system, one or more S-12 units may be used in combination with one or more control selectors (such as the Ling Model DA-10B) to control one of the outputs of the S-12 units. The S-12 input signals are proportional to shaker velocity, and it produces output signals and meter readings proportional to both displacement and acceleration; the S-12 input signals can also be proportional to shaker acceleration and will produce an output and a meter reading proportional to acceleration.

1-2. PURPOSE

The purpose of the S-12 is to supply an output, for control purposes, and to meter displacement and acceleration in vibration testing systems.

1-3. SPECIFICATIONS

Power requirements . . . . . 115 vac, 60 cps, 75 watts

Input transducer . . . . . Velocity for D
Velocity or acceleration for G

Input signal . . . . . Velocity, 68.1 mv rms per in/sec peak
Acceleration, 10 mv rms per G peak

Input impedance . . . . . Velocity, 50K
Acceleration, 100K

Full scale ranges . . . . . Displacement, 0.1 inch da
1.0 inch da
Acceleration 5G, 10G, 50G, 100G

Signal output . . . . . 0.7 v rms (nominal)

Accuracy . . . . . ±5% rms of full scale

Frequency range . . . . . 5 to 5000 cps

Weight . . . . . Approximately 35 pounds

TABLE 1-1 TUBE COMPLEMENT

REFERENCE DESIGNATION	TYPE	FUNCTION
V1	6SL7GT	Input amplifier, G channel from velocity or acceleration pickup
V2	6SL7GT	G channel amplifier
V3	6SL7GT	G channel amplifier and cathode follower

TABLE 1-1 TUBE COMPLEMENT (cont.)

REFERENCE DESIGNATION	TYPE	FUNCTION
V4	6SL7GT	Input amplifier, D channel from velocity pickup
V5	6SL7GT	D channel amplifier and cathode follower
V6	5Y3GT	Rectifier, power supply
V7	OC3	Reference tube, voltage regulator
V8	6SH7	Regulator amplifier
V9	6Y6G	Series regulator
V10	OB2/VR105 or OA2/VR150	Regulator

TABLE 1-2 SEMICONDUCTOR COMPLEMENT

REFERENCE DESIGNATION	TYPE	FUNCTION
CR1	1N54	Meter rectifier, G channel
CR2	1N54	Meter rectifier, G channel
CR3	1N54	Meter rectifier, D channel
CR4	1N54	Meter rectifier, D channel
CR5	1N54	Linearity correction
CR6	1N54	Linearity correction
CR7	10F1	Filament rectifier
CR8	10F1	Filament rectifier
CR9	10F1	Filament rectifier
CR10	10F1	Filament rectifier

SECTION 2
OPERATION

2-1. INSTALLATION

a. The S-12 is shipped with all tubes in place and ready to operate. A visual inspection should be made after unpacking for evidence of shipping damage, loose knobs, tubes or components.

b. The S-12 is designed for rack mounting and is installed according to the instructions applicable to the system with which it is to be used. Connections are made to plugs and to a terminal strip on the rear of the chassis. Proper connections for the unit are listed in table 2-1.

TABLE 2-1 INPUT CONNECTIONS

RECEPTACLE	CONNECTION
J1	Velocity pickup, Cannon XL connector
J2	Velocity Pickup, Cannon XL connector
J3	Accelerometer (via external cathode follower) Cannon XL connector
J4	External cathode follower voltages, Cannon connector
J4B	Accelerometer input, Amphenol UG - 1094/u
TB1-1	Chassis ground
TB1-2	Circuit ground
TB1-3	115 vac
TB1-4	115 vac
TB1-5	Circuit ground
TB1-6	D output to servo or control selector
TB1-7	G output to servo or control selector
TB1-8	Input from selector (D or G)
TB1-9	Circuit ground
TB1-10	AGC output to servo from function switch on S-12 (when used with a control selector)
TB1-11	Spare
TB1-12	Spare

NOTE

CONNECTIONS TO PLUGS J1, J2 AND J3 ARE, INNER SHIELD TIED TO PIN 1, OUTER SHIELD TIED TO PIN 3 AND THE SIGNAL LEAD TIES TO PIN 2. J4 HAS CONNECTIONS TO SUPPLY B+ TO THE ACCELEROMETER PREAMPLIFIER. J4B IS A SHIELDED COAXIAL CONNECTION.

c. Initial installation of Ling vibration testing systems and components is normally accomplished by the customer. The customer is also responsible for supplying the necessary space, materials and interconnections. When technical assistance is desired, arrangements may be made for Ling field service personnel to assist in setting up the equipment, initial checkout, test and briefing instructions.

d. Before operating the S-12, make certain that all connections listed in table 2-1 are properly made. The unit should be installed in a well ventilated rack or console, away from strong electrical fields. Dimensions that may be required for installation are given in figure 2-1.

TABLE 2-2 FRONT PANEL CONTROLS (see figure 2-2)

FRONT PANEL MARKING	REFERENCE DESIGNATION	DESCRIPTION AND FUNCTION
"D "(meter)	M1	Milliammeter; meters displacement on shaker, depending on the displacement range switch setting. Calibrated corresponding to displacement readings of 0.01 - 0.1 or 0.1 - 1.0 inch da.

TABLE 2-2 FRONT PANEL CONTROLS (cont.)

FRONT PANEL MARKING	REFERENCE DESIGNATION	DESCRIPTION AND FUNCTION
"G" (meter)	M2	Microammeter; meters velocity or acceleration on shaker, depending on the acceleration range switch setting. Calibrated corresponding to acceleration readings of 0.5 - 5G, 1.0 - 10G, 5.0 - 50G, and 10 - 100G.
ACCELERATION "G" VECTOR	R22	Potentiometer; sets output level on G channel. Rough calibration on front panel is from 5 - 50G peak.
DISPLACEMENT INCHES TOTAL	R39	Potentiometer; sets output level on D channel. Rough calibration on front panel is from 0.04 - 0.8 inch da.
(No marking for function switch)	S1	Rotary switch; four position switch that selects the mode of servo operation; MANUAL (AGC output to servo grounded), "D" (AGC output to servo acting on displacement only), "G" (AGC output to servo acting on acceleration only), AUTOMATIC (AGC output to servo acting on either D or G signal whichever is selected by a control selector external to the S-12).
VELOCITY PICKUP	S2	Rotary switch; two position switch that selects velocity pickup 1 or 2; velocity pickups are connected to J1 and J2.
(No front panel marking for the accelerometer selector)	S3	Rotary switch; three position switch that selects ACCELEROMETER 1 or ACCELEROMETER 2 inputs from J3 and J4B or DIFFERENTIAL VELOCITY position that is connected to a velocity pickup that is selected by the VELOCITY PICKUP selector.
(No front panel marking for the acceleration range switch)	S4	Rotary switch; four position switch that selects the multiplying factor for the acceleration meter scale in ranges 5G, 10G, 50G, and 100G.
(No front panel marking for the displacement range switch)	S5	Rotary switch; two position switch that selects the multiplying factor for the displacement meter scale, D X 0.1 and D X 1.0.

2-2. OPERATION

a. The S-12 ac power is controlled by switches or circuit breakers external to the unit (there is no power switch on the S-12). Allow at least a five minute warmup period before operation, after power is applied.

b. The S-12 is normally a part of an over-all servo system; its operation is in conjunction with the other units of that system. The operating procedure to be followed is given in the instructions for the particular servo system with which it is used.

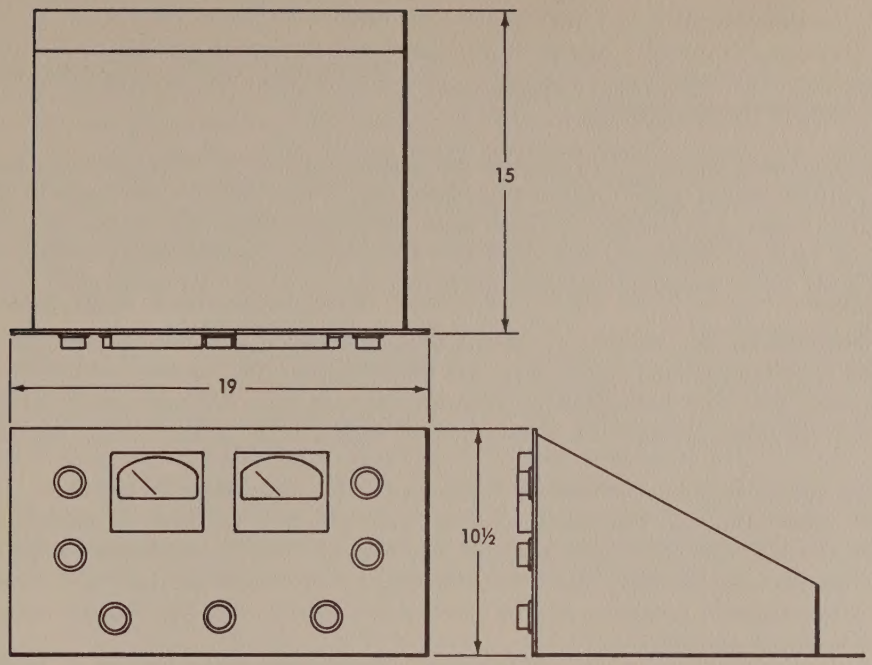

Fig. 2-1 Model S-12-D and G Amplifier, Installation Drawing

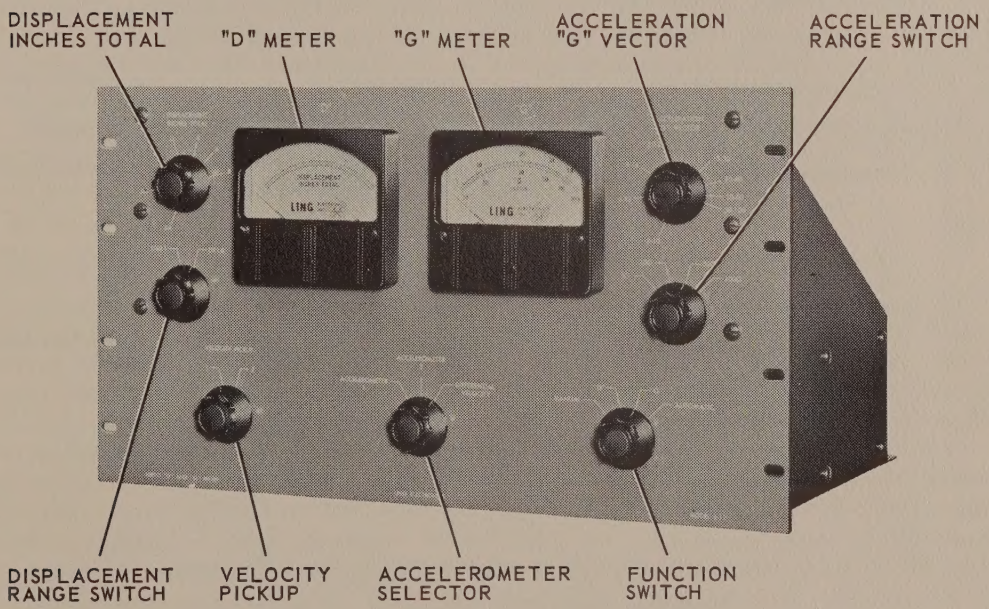

Fig. 2-2 Model S-12-D and G Amplifier, Front View

SECTION 3
PRINCIPLES OF OPERATION

3-1. INTRODUCTION (See figure 3-1)

a. The Ling Model S-12-D and G Servo Amplifier measures acceleration and displacement in vibration testing systems; it provides an output for each of these quantities for control applications.

The S-12 is normally used as a part of the Ling Model S-11 Servo System, and it is the component which supplies the control signal to the main servo control amplifier. The S-12 is normally operated from a velocity transducer input; provision is made for an accelerometer input to the G channel (not for displacement).

b. Operating controls on the S-12 establish the operating level of vibration (displacement or acceleration) at the shaker when the servo is operating; it also selects the mode of operation for the servo. The servo will control a given meter reading (signal output) on the S-12; if the range switch (D or G) is changed, the level of vibration will automatically change by a calibrated factor (if the servo is operating and controlling on that particular quantity).

c. It is not advisable to change any switch setting or other controls, except the output controls for D and G (displacement inches total and acceleration "G" vector), while the power amplifier is turned on. This is a precaution to avoid introducing switching transients and thumps into the system; these might damage the shaker and/or specimen or produce shut-down of the amplifier.

d. Operation of the S-12 with a random signal is not recommended, as accuracy will be seriously affected. The S-12, and the servo systems with which it is used, is designed for sinusoidal vibration testing. The acceleration meter, when used with an accelerometer input, may be used for random signals (multiply the scale reading by 0.8 to obtain the rms value of the random acceleration signal); accuracy of this method depends on the bandwidth; accuracy is reduced as the bandwidth narrows.

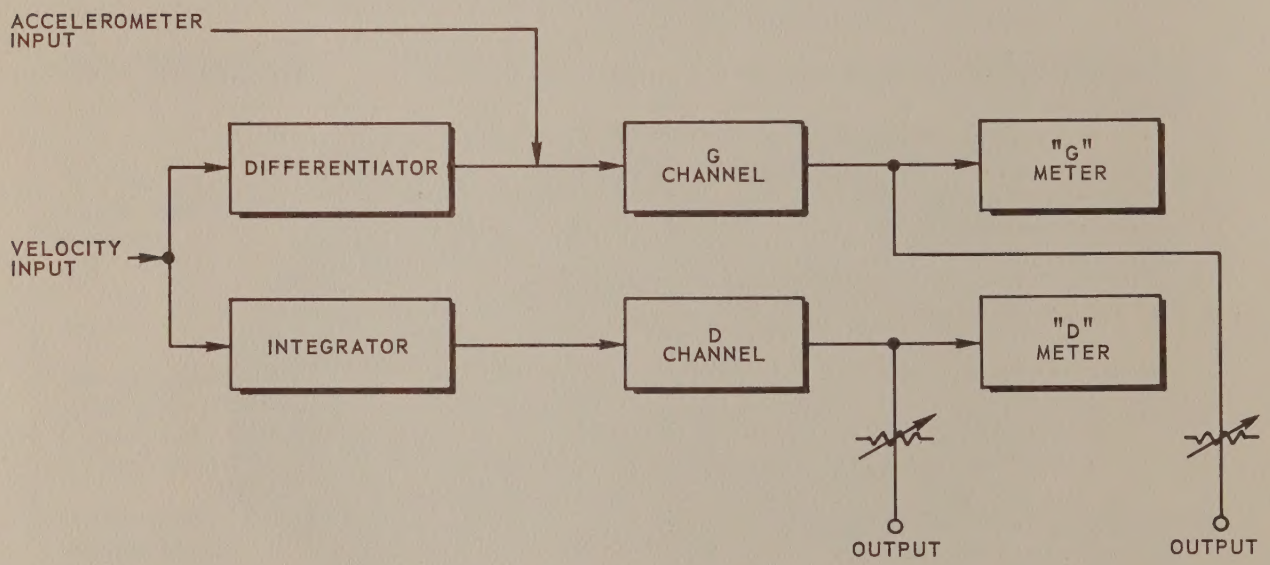

Fig. 3-1 Model S-12-D and G Amplifier, Block Diagram

e. The S-12 is designed so a velocity transducer will produce both displacement and acceleration readings and outputs; normal usage of the S-12 is with this type of transducer. Some tests are more conveniently conducted using an accelerometer. Two accelerometer inputs (J3 and J4B) are provided in the S-12; the G channel may be switched to either of these inputs. Factory calibration of each of these inputs is on the basis of 1 mv rms per G peak; accelerometers having other calibrations may be used if the S-12 is readjusted. Should readjustment be required refer to paragraph 4-4.

3-2. G CHANNEL CIRCUIT DESCRIPTION

The S-12 two main channels are, acceleration (G channel) and displacement (D channel). The G channel is shown in the upper portion of Schematic 4104. Either of two velocity pickups is selected by transducer selector S2 and the signal from the transducer is applied simultaneously to the D and G channels. V1A is the input amplifier for the G channel followed by cathode follower V1B. A differentiating network C3/R8 is at the output of V1B to provide a −3 db cutoff of 24000 cps; this produces a signal proportional to acceleration over the frequency range. This signal, or one proportional to acceleration (obtained from the accelerometers connected to input plugs J3 and J4B) is selected by accelerometer selector switch S3. The selected signal is amplified by gain stabilized amplifier V2 and V3A. Gain stabilization and gain control is produced by negative feedback from the cathode of V3A back to the cathode circuit of V2A via potentiometer R55 in 5G and 10G positions; in the 50G and 100G positions, switch S4 shunts R55 and the signal is applied directly to potentiometer R12. The settings of R12 and R55 establish the gain of the amplifier in the 5G and 10G positions; in the 50G and 100G positions of S4, R12 controls amplifier gain. Maximum feedback is applied with R55 shorted out by S4 in the 50G and 100G position; this results in minimum amplifier gain. Amplifier gain is increased, with R55 not shorted (S4 in the 5G or 10G position), by a factor of 10 (when properly adjusted) due to the reduction in feedback. Output of the gain stabilized amplifier is applied to cathode follower V3B, which drives both the metering circuit and the output.

3-3. D CHANNEL CIRCUIT DESCRIPTION

The D channel is similar in operation to the G channel except that an integration must be performed to obtain displacement from the velocity transducer. The integration is made at the input to the D channel by R24 and C9; they act as a low pass filter with a −3 db cutoff frequency of about 0.3 cps. The integrated signal, now proportional to displacement over the frequency range, is amplified by gain stabilized amplifier V4 and V5A. This amplifier is identical to the G channel gain stabilized amplifier, with the addition of R32 in the feedback path to increase the minimum gain slightly over that of the G channel amplifier. Output is taken from cathode follower V5B to supply the metering circuit and the output.

3-4. METERING CIRCUITS

The metering circuits in both D and G channels operate in the same way; they differ only in the choice of component values to achieve the correct degree of meter linearity and range. Each meter circuit is capacity coupled to the cathode follower output via C22 in the G channel and C7 in the D channel. Type 1N54 diodes are used as a full wave rectifier so current flows through the meter on both half cycles of the applied voltage. Potentiometers R54 and R52, screwdriver adjustments, control the meter sensitivity and establish the range of current corresponding to full scale meter deflection. Resistors R15 and R41, in combination with 1N54 diodes (CR5 and CR6 respectively), shunt the meter circuit and correct for non-linearity of the rectifier diodes. R15 and R41 resistances are nominal values; the exact value is selected at the factory for each S-12 unit. C27 and C28 filter the higher frequency components of the rectified signal. Each meter circuit responds to the average value of the input signal from its respective cathode follower; it is calibrated to read peak (G) or peak-to-peak (D) of a sine wave. Non-sinusoidal error will be an amount dependent on harmonic content.

3-5. FUNCTION SWITCH

The output is controlled by panel mounted potentiometers R22 and R39, for G and D channels respectively. The function switch, S1, has four positions, MANUAL, D, G, and AUTOMATIC. In the MANUAL position, the AGC line to the servo control amplifier is grounded; no servo

operation can take place and gain must be adjusted manually. In D or G position, the AGC line is switched to an external control selector, such as the Ling Model DA-10B, which chooses D or G signals for control purposes.

3-6. POWER SUPPLY

a. The power supply for the S-12 is an integral part of the unit and is shown in the lower portion of schematic 4104. V6 is a conventional full wave rectifier operating from voltage supplied by transformer T1. A two section capacitor input filter is used for the unregulated B+; it is followed by an electronic voltage regulator consisting of series regulator tube V9, amplifier V8 and reference tube V7. A portion of the screen voltage for V8 is supplied, via resistor R64, from the unregulated side of the power supply; this improves the regulator performance by reducing ripple or other input voltage variations. C20 bypasses the output voltage divider to increase the loop gain of the regulator; ripple reduction and passing higher frequencies also aids in improving the regulation. The regulated power supply is designed to supply an output voltage of 230 vdc. Plate voltage for the last two stages of the D channel amplifier, V5A and V5B, is taken from the unregulated side of the power supply via decoupling circuit R60 and C15; these two tube sections require slightly higher plate voltage to produce a larger voltage swing, without generating distortion or non-linearity.

b. An auxiliary output of either 105 vdc or 150 vdc is furnished by V-10. V-10 is an OB2 (105 vdc) or an OA2 (150 vdc); their output is applied to pin 4 of J4 to supply external power to an accelerometer preamplifier. A filament rectifier and filter (CR7-10, C21, C24 and R69) supply an adjustable 6 vdc output to pin 1 of J4 for preamplifier use.

SECTION 4
MAINTENANCE

4-1. ANALYSIS

a. The first step in servicing a defective S-12 is to localize the fault. Some faults, such as burned out resistors, arcing and shorted transformers, can be located by sight, smell or hearing.

b. The following are a group of tests arranged to simplify and reduce unnecessary work and aid in tracing a trouble to a specific circuit or component.

(1). Visual inspection may disclose the trouble or determine the circuit in which the trouble exists.

(2). Voltage and resistance measurements will help locate the defective component(s) when the readings are compared with the normal readings shown on the charts (see tables 4-5, 4-6 and figure 4-3).

(3). Trouble shooting symptoms are listed in table 2-1 to aid in determining the defective part.

(4). Intermittent conditions should not be overlooked when conducting these tests. This type of trouble may often be made to appear by tapping or jarring the equipment.

4-2. TROUBLE SHOOTING (see figures 4-1 and 4-2)

a. The following troubleshooting procedures are meant to be a basic guide to the possible root of troubles encountered.

TABLE 4-1 TROUBLE SHOOTING

TROUBLE	LOCATION	CAUSE AND/OR REMEDY
Unit does not come on when power is applied	Internal	Check fuse (F1).

TABLE 4-1 TROUBLE SHOOTING (cont.)

TROUBLE	LOCATION	CAUSE AND/OR REMEDY
Fuse F1 blown	Internal	Check for bad rectifier tube (V6). Check for blown filter capacitor (C14 or C16). Check for short circuit in power supply or in power transformer.
Power supply voltage will not regulate or adjust to 230 vdc	Internal	Check reference tube (V7). Check regulator amplifier (V8). Check series regulator (V9). Check for excessive drain on supply; possibly C15 or C30 are blown. C15 blowing will cause R60 to become hot. Check for open potentiometer (R46).
Meter reading highly non-linear	Internal	Check diodes CR5 or CR6 for the affected meter. Check meter rectifiers CR1 and CR2 or CR3 and CR4 for the affected meter (on rear of meters).
Distortion or low gain	Internal	Check tubes V1 - V3 in G channel. Check tubes V4 and V5 in D channel. Check power supply voltage.
G channel accuracy out of tolerance	Internal	Check G channel tubes. Check differentiating network C3/R8.
D channel accuracy out of tolerance	Internal	Check D channel tubes. Check integrator R24/C9.

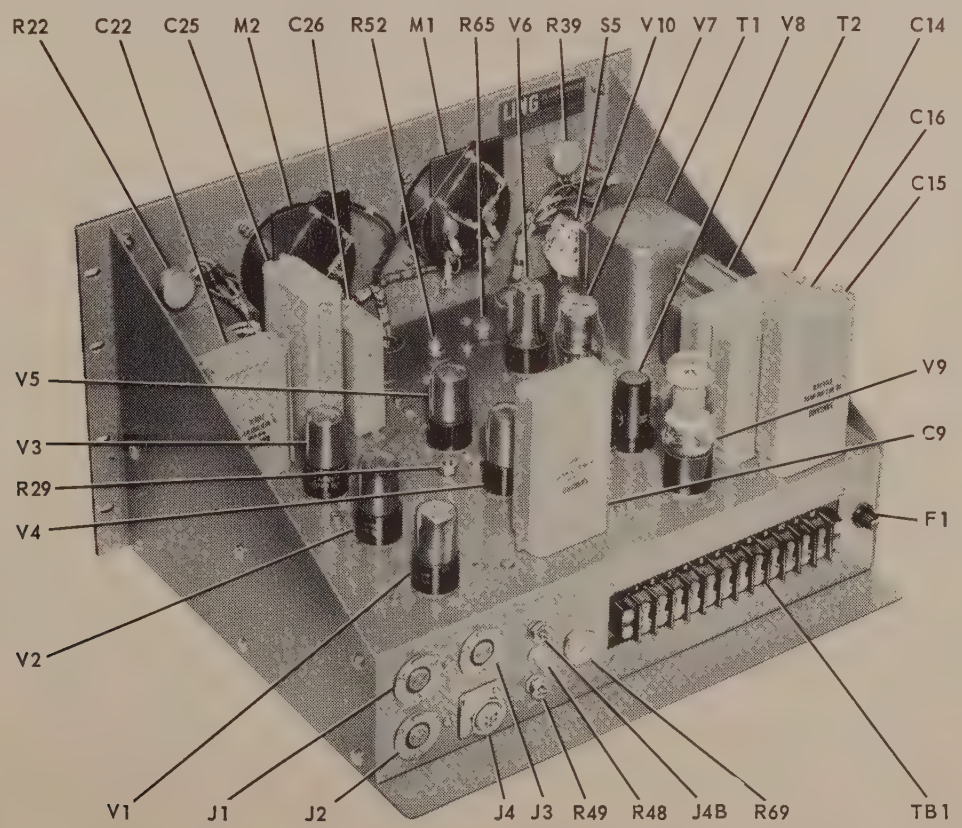

Fig. 4-1 Model S-12-D and G Amplifier, Top View

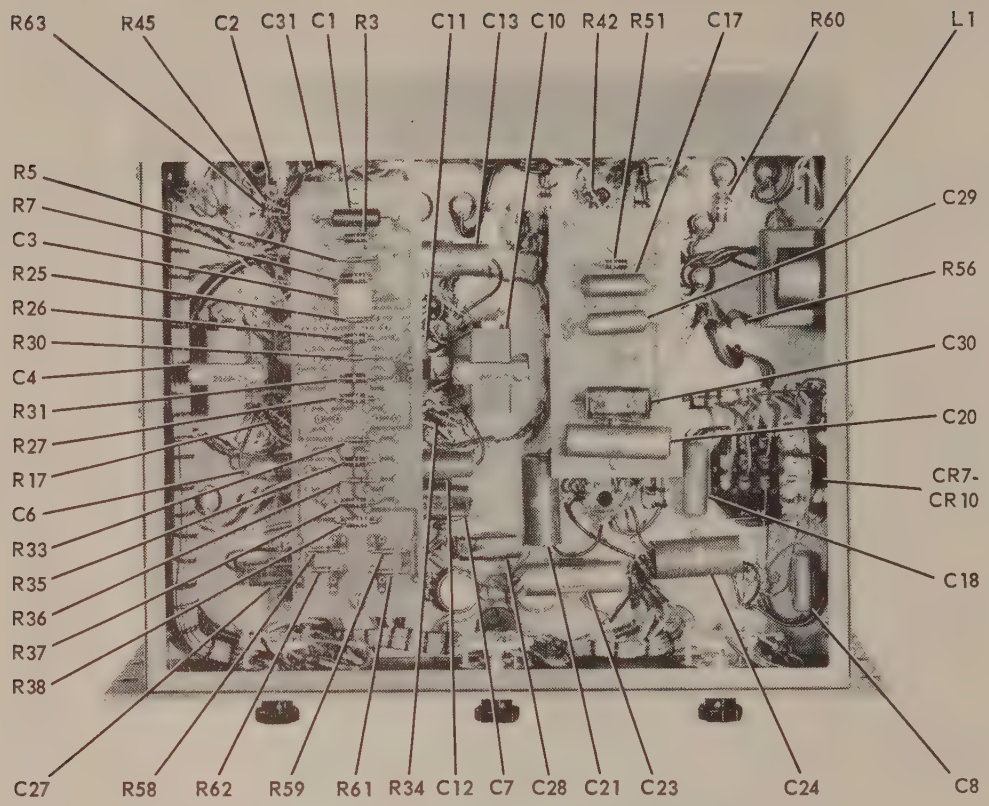

Fig. 4-2 Model S-12-D and G Amplifier, Bottom View

4-3. TEST EQUIPMENT

a. Variac, General Radio Model 6RWSM-T3 or equivalent.

b. Wattmeter, Triplett Model 660 or equivalent.

c. Multimeter, Simpson Model 270 or equivalent.

d. Audio Oscillator, Hewlett Packard Model 202C or equivalent.

e. Distortion Analyzer, Hewlett Packard H01 330B or equivalent.

f. Calivolter, Calidyne Model A-23 or equivalent.

g. Resistor, 15 ohms, 5 watt 10%.

4-4. TESTING AND CALIBRATION

a. Preliminary Front Panel Control Adjustments.

(1). Set the **VELOCITY PICKUP** selector (S2) to 1.

(2). Set the accelerometer selector (S3) to **DIFFERENTIAL VELOCITY.**

(3). Set the function switch (S1) to "G".

(4). Set the displacement range switch (S5) to D X 1.0.

(5). Set the acceleration range switch (S4) to 50G.

(6). Set the **ACCELERATION "G" VECTOR** (R22) to 5.

(7). Set the **DISPLACEMENT INCHES TOTAL** (R39) to 0.04.

b. Preliminary Connections

(1). Connect a jumper from TB1-1 to TB1-2.

(2). Connect an external ground to TB1-1.

(3). Connect the output of the Variac to TB1-3 and TB1-4; the Variac is then plugged into the Wattmeter which is plugged into 115 vac; the Variac should be turned off.

(4). Connect the Distortion Analyzer (set **FUNCTION** switch to **NOISE**) and the Multimeter (set to 1000 vdc range) to pin 3 of V9.

(5). Connect the Oscillator signal lead to J1-2; connect the shield to J1-1.

(6). Connect the 15 ohm resistor from J4-1 to J4-2.

c. Power Supply Tests

NOTE

ALL INPUT VOLTAGES ARE RMS AS MEASURED WITH A CALIVOLTER.

(1). Slowly increase Variac output to 117 volts with no input signal; wattmeter reading should not exceed 85 watts. Voltage at V9-3 should rise to approximately +405 vdc; record this voltage and the ac ripple value.

(2). Connect the Multimeter and Distortion Analyzer leads to V9-8. Adjust R46 for 230 vdc; ripple voltage should be 60 db or more below 1 volt rms. Vary the line voltage from 105 to 120 vac; the readings should not vary appreciably.

(3). Connect the Multimeter and Distortion Analyzer to J4-1. Adjust R69 for 6.3 vdc and measure the ripple value.

(4). Connect the Multimeter and Distortion Analyzer to J4-4. Measure and record the dc voltage (104 vdc or 150 vdc) and ripple.

(5). Disconnect and remove the Wattmeter.

d. Operational Amplifier Calibrations

(1). Connect the Distortion Analyzer to TB1-10.

(2). Adjust J1 input to 0.21 v rms at 100 cps.

(3). Adjust R12 for 0.7 v rms at output at TB1-10.

(4). Adjust R54 for a 5 G indication on the "G" meter.

(5). Set acceleration range switch (S4) to 5 G.

(6). Adjust R55 for a 5 G indication on the "G" meter.

(7). Voltage at TB1-10 must be 7.0 v rms ±0.35 v rms.

(8). Set acceleration range switch to 100 G and set function switch (S1) to "D".

(9). Adjust J1 input to 0.86 v rms at 100 cps.

(10). Adjust R29 for 0.7 v rms at output, TB1-10.

(11). Adjust J1 input to 2.14 v rms at 100 cps.

(12). Adjust DISPLACEMENT INCHES TOTAL for 0.7 v rms output at TB1-10.

(13). Adjust R52 for 1.0 inch indication on the "D" meter.

(14). Set the displacement range switch (S5) to D X 0.1.

(15). Adjust R65 for 0.1 inch indication on the "D" meter.

(16). Voltage at TB1-10 must be 7.0 v rms ±0.35 v rms.

(17). Set the function switch (S1) to "G"; Set the displacement range switch (S5) to D X 1.0 and DISPLACEMENT INCHES TOTAL (R39) fully CCW.

e. "G" Channel Noise Measurement

(1). Adjust J1 input to zero v rms and R57 for minimum ripple at TB1-10.

(2). Ripple measurements should meet the levels set forth in the table 4-2.

TABLE 4-2 RIPPLE MEASUREMENT

ACCELERATION RANGE SWITCH (S-4)	MAXIMUM RIPPLE, BELOW 1 VOLT
100 G	41 db
50 G	47 db
10 G	17 db
5 G	23 db

f. G Channel Distortion Measurement

(1). Set the acceleration range switch to 50 G.

(2). Adjust J1 input to 4.2 volts at 25 to 50 cps to make distortion measurements at TB1-10; should be less than 2%.

(3). Set the acceleration range switch to 5 G.

(4). Measure distortion on TB1-10 with an input to J1 of 0.42 v rms at 50 cps; should be less than 2%.

g. G Channel Accuracy

(1). Adjust the input to J1 to the values and frequencies indicated below. Check the output voltages at TB1-10 and the indications of the "G" meter; these should agree within 5% of the values listed in table 4-3. Adjust the acceleration range switch (S4) as indicated in table 4-3.

TABLE 4-3 G METER INDICATORS AND ACCELERATION RANGE SWITCH POSITIONS

FREQUENCY IN CPS	V RMS INPUT (J1)	"G" METER	V RMS OUTPUT (TB1-10)	ACCELERATION RANGE SWITCH (S4)
25	0.336	2	2.8	5G
25	0.336	2	1.4	10G
25	1.68	10	7.0	10G
25	1.68	10	1.4	50G
100	0.84	20	2.8	50G
100	0.84	20	1.4	100G
500	0.252	30	2.1	100G
500	0.252	30	4.2	50G
2000	0.084	40	5.6	50G
2000	0.084	40	2.8	100G

(2). Set acceleration range switch to 50G.

h. D Channel Noise Measurement

(1). Set function switch (S1) to "D".

(2). Adjust J1 input for zero v rms; ripple at TB1-10 should be 43 db or more below 1 volt.

(3). Set the displacement range switch (S5) to D X 0.1; ripple at TB1-10 should be 23 db or more below 1 volt.

i. D Channel Distortion Measurement

(1). Set the displacement range switch (S5) to D X 1.0.

(2). Adjust J1 input to 6.415 v rms at 30 cps and measure the distortion at TB1-10; should be less than 2%.

(3). Set displacement range switch (S5) to D X 0.1 and measure distortion the same as in the last step; should be less than 2%.

j. D Channel Accuracy

(1). Adjust J1 input to the values and frequencies listed below. Check the output voltages at TB1-10 and the indications on the "D" meter; these should agree within 5% of the values listed in table 4-4. Adjust the displacement range switch (S5) as indicated in table 4-4.

TABLE 4-4 D METER INDICATORS AND DISPLACEMENT RANGE SWITCH POSITIONS

FREQUENCY	V RMS INPUT (J1)	"D" METER	V RMS OUTPUT (TB1-10)	DISPLACEMENT RANGE SWITCH (S5)
10	0.4276	0.2	3.5	D X 1.0
25	1.069	0.2	3.5	D X 1.0
100	1.71	0.08	14.0	D X 0.1

(2). Set the displacement range switch (S5) to D X 1.0.

k. Control Function Tests

(1). Adjust and maintain J1 input to 1.71 v rms at 100 cps.

(2). Turn the function switch (S1) to "D" and "G" alternately to identify each signal as it appears at TB1-10.

(3). The G signal should appear at TB1-7; its level is adjustable with the ACCELERATION "G" VECTOR control (R22).

(4). The D signal should appear at TB1-6; its level is adjustable with the DISPLACEMENT INCHES TOTAL control (R39).

(5). Set the function switch (S1) to AUTOMATIC. Set the ACCELERATION "G" VECTOR (R22) and DISPLACEMENT INCHES TOTAL (R39) controls fully CCW. Jumper TB1-7 and TB1-8. The G signal should be present at TB1-10. Remove jumper.

(6). Set the function switch to MANUAL. Check for continuity between TB1-2, 5, 9, and 10.

(7). Connect a 1.71 v rms input to J2 and set the function switch (S2) to "G". Turn the VELOCITY PICKUP selector (S2) to 2; the G signal should appear at TB1-10.

(8). Set the function switch (S1) to "D". Set the accelerometer selector (S3) to ACCELEROMETER 1. The D signal should appear at TB1-10.

(9). Set the function switch (S1) to "G". No signal should be present at TB1-10.

l. Accelerometer Input Calibration

(1). Reduce the input to 0.0171 v rms at 100 cps and move from J2 to J3.

(2). Indication on the "G" meter should vary with the adjustment of R48; adjust R48 for maximum "G" meter indication.

(3). Calculate the maximum accelerometer input sensitivity from the following formula:

$$\frac{17.1}{\text{G indication}} = \text{mv/G}$$

(4). Set R48 for minimum.

(5). Move the 0.0171 input to J4. Set accelerometer selector (S3) to ACCELEROMETER 2. "G" meter should vary with the adjustment of R49; for a minimum indication.

(6). Adjust J4 input for 0.1 v rms at 100 cps. Adjust R49 for a 10 G indication on the "G" meter.

(7). Move 0.1 v rms, at 100 cps, input to J3. Set accelerometer selector (S3) to ACCELEROMETER 1. Adjust R48 for 10 G indication on the "G" meter.

m. Test Complete

(1). Disconnect all test equipment.

4-5. VOLTAGE AND RESISTANCE CHECKS (see tables 4-5, 4-6 and figure 4-3)

a. Voltage and resistance measurements are made following the conditions set forth below:

(1). Set the DISPLACEMENT INCHES TOTAL control to 0.04.

(2). Set the VELOCITY PICKUP to 1.

(3). Set the accelerometer selector to ACCELEROMETER 1.

(4). Set the ACCELERATION G VECTOR control to 5.

(5). Set the acceleration range switch to 100G.

(6). Set the function switch to MANUAL.

(7). All other adjustments are established by calibration.

(8). Point-to-point measurements are made from TB1-1.

b. Measurements are taken with a 500 ohm/V meter on AC and a 20,000 ohm/V meter on DC. Refer to Ling Schematic 4104 for additional information.

TABLE 4-5 VOLTAGE MEASUREMENTS

TERMINAL OR JACK NO.	1	2	3	4	5	6	7	8	9	10
J-1	0	0	0							
J-2	0	0	0							
J-3	0	0	0							
J-4B	0									
J-4	8.9	0	---	*	0	0				
TB1	---	0	**	**	0	0	0	0	0	0

Jumper TB1-1, 2, J1-2, J2-2, J3-2 and J4B for the above measurements.

* OB2 (+105v) or OA2 (+150v)
** 117 vac input

TABLE 4-6 RESISTANCE MEASUREMENTS

TERMINAL OR JACK NO.	1	2	3	4	5	6	7	8	9	10
J-1	0		0							
J-2	0		0							
J-3	0	100K	0							
J4B	100K									
J-4	250K	0	---	115K	100K	0				
TB-1	---	0			0	50K	25K		0	0

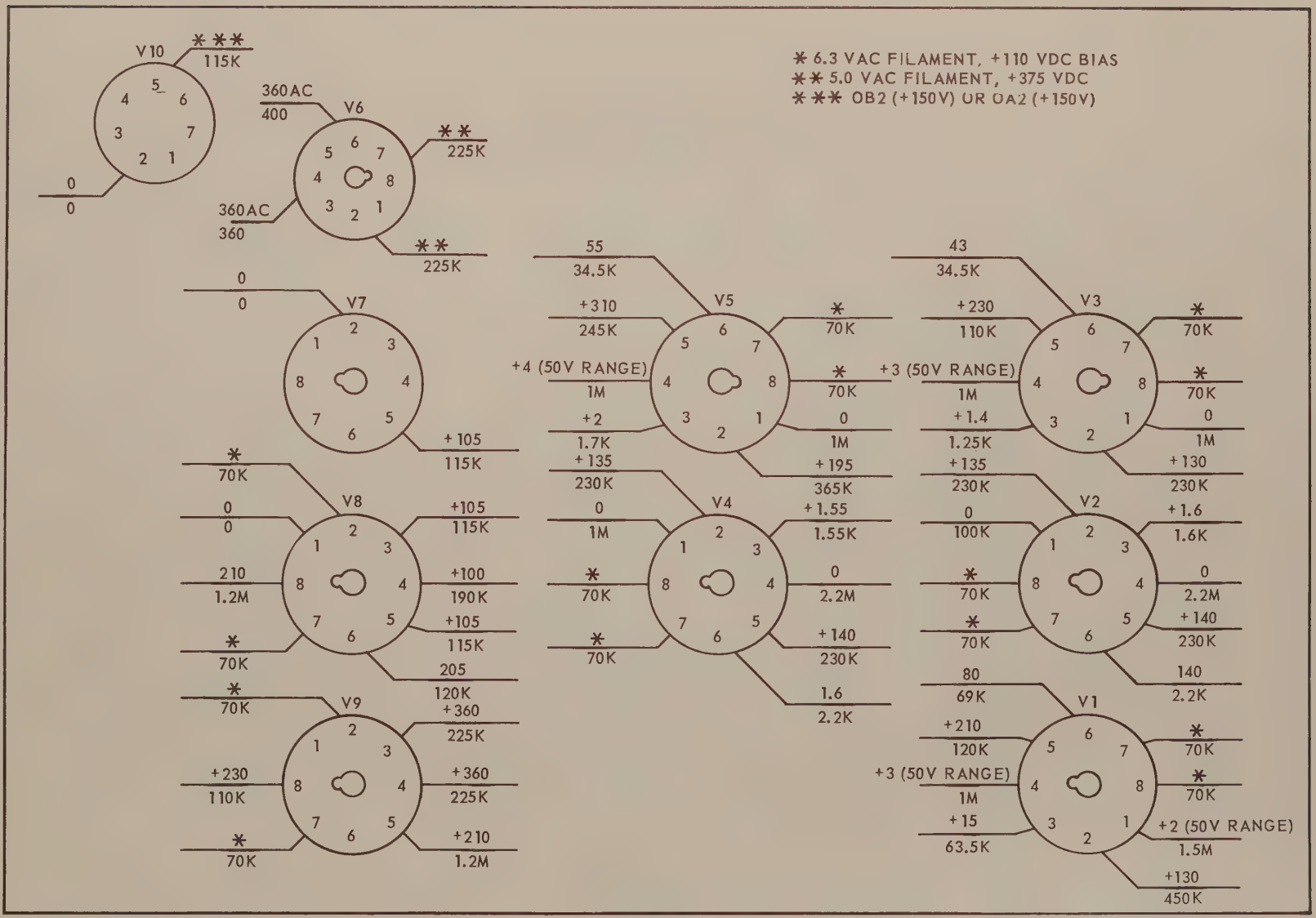

Fig. 4-3 Model S-12-D and G Amplifier, Voltage and Resistance Diagram

4-6. ADJUSTMENTS

a. Hum Adjustment

(1). Hum adjustment potentiometer R57, is located on the chassis near filament transformer T2; it is in the filament circuit for tubes V1 through V5, V8 and V9. To set this adjustment, short the input to J1 and connect a VTVM or an oscilloscope to TB1-10 (signal); connect the shield to TB1-9. Set all controls the same as in 4-4. a. with power supplied and adjust R57 for minimum hum output; hum should be less than 7 mv rms.

b. Accelerometer Input Adjustment

(1). Potentiometers R48 and R49 are located on the rear of the S-12 chassis (screwdriver adjustments) for attenuation of the accelerometer channel. R48 controls the attenuation from input connector J3; ACCELEROMETER 1 position of selector switch S3. R49 controls attenuation from input connector J4; ACCELEROMETER 2 position of selector switch S3.

(2). The vibration testing system may be set manually for a vibration level of 5G at a frequency of 100 cps. The accelerometer is mounted directly on the shaker table and is connected via a cathode follower or an isolating amplifier to the input connector, J3 or J4. The potentiometer (R48 or R49) corresponding to the input selected (J3 or J4) may be adjusted so the "G" meter reading is the same with S3 switched to ACCELERATION 1 or ACCELERATION 2 as it is with S3 switched to DIFFERENTIAL VELOCITY. This procedure assumes that the system is set up and operating with a velocity pickup as the normal input. The accelerometer is now calibrated and may be mounted on the test specimen or fixture. Should accelerometer sensitivity be insufficient to produce the required voltage, additional amplification will be necessary, external to the S-12.

4-7. CLEANING

The only cleaning necessary for the S-12 is to keep the chassis free of dust. To clean the chassis use low pressure air, a vacuum cleaner or a soft brush to remove the dust.

4-8. OTHER DIFFICULTY

In the event of troubles or problems not covered by this manual, contact the factory, giving serial number, Ling number, conditions of use, and a full description of the problem. Ling field service personnel are constantly available for consultation on special problems concerning utilization or application of Ling equipment, and upon making the necessary arrangements, can be on the scene within 24 hours.

S-12-D Schematic 4104R

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